Reflections on the invisible

AUTHOR(S):

Santos, Luciano Henrique de Oliveira

デザイン学論考, vol.15, pp.87-98, 2019.

Reflections on the invisible
不可視性についての一考察

Luciano Henrique de Oliveira Santos

3rd year PhD student of Dept. of Social Informatics, Grad. School of Informatics, Kyoto Univ.
2nd generation student of Collaborative Graduate Program in Design

1. Calm technology

The acclaimed Xerox engineer, Mark Weiser, became famous for pointing out one of those facts that may seem obvious once you take a moment to think about them, but require a particularly ingenious mind to finally be said out loud – "the most profound technologies are those that disappear"[i]. At the time of making this observation, he was probably completely unaware that he was creating a whole new branch of Computer Science, and, yet, what he called *calm technology*[ii] later became the foundation of the modern field of *ubiquitous* or *pervasive* computing. But what exactly did Weiser mean by *disappear*?

Imagine it's late at night, and you finally arrive at home, after a long and exhausting day of work. The only thing in your mind right now is taking off your clothes and entering a relaxing bath. As you calmly relieve your soul from strains of the day in the ecstatic embrace of the hot water, do you think you would ever stop to ask yourself from *where* that water comes? From which river or lake is was collected? Which treatment station handled it? What kind of pipes led it to your bathroom?

Now suppose that after you have finished bathing and getting ready to sleep, while you lay in bed organizing your thoughts and preparing your heart for new tribulations on the following day, you suddenly decide to watch a few minutes of your favorite late-night show. Do you ask yourself how exactly the TV turns on? How the electric power giving life to the *manzai* comedian screaming from the screen finally arrived at your home? How the channel's content is magically transmitted to your bedroom?

[i] Weiser, M. The computer for the 21st century. *Scientific American*, Vol. 3, p. 66-75, 1991.
[ii] Weiser M, Brown JJS. Designing Calm Technology. *POWERGRID*, Vol. 1, p. 1-5, 1996.

Even though most people have at least a rough idea of how the water supply system or the power grid work, these technologies are still used in everyday life without requiring a single moment of hesitation from the users to consider their inner workings. In fact, when these systems are used, people don't even think about the *systems themselves*. People worry about *taking a bath*, not about *accessing the water supply*. People focus on *watching TV*, not on *connecting the electric power* or *tuning the appropriate broadcast frequency*. These technologies are so ingrained in our everyday actions that they become hidden assumptions of a more general task, *i.e.*, they become *invisible*.

Perhaps one of the oldest and, thus, least frequently thought of examples of invisible technology are *writing systems*. When you use such a system, regardless of the situation – if you are writing a formal e-mail to your department head or a casual joke to a friend on LINE – you are not concerned about the specific shape of the characters or how they combine to form sounds – well, kanji can be especially spiky in that front, but still, the point is – your main focus are the thoughts in your head and how to better express them, *i.e.*, which tone to use, the choice of words, the intended meaning, the level of formality, *etc*. It's not surprising at all that most people don't realize that writing is an invisible technology – a system that has existed for millennia and yet is probably the most widely used technology in modern human life is *expected* to be invisible. Like Weiser said, the most profound technologies are.

A defining characteristic of invisible technologies is that we only become aware of their existence precisely when they do not work. People do reflect about the workings of the power grid or the water supply when the lights suddenly turns off or when they receive a notice of water shortage for the day. People do care about the shape and sound of the characters when they can't remember the correct kanji for a specific technical term or ancient word. However, they need to explicitly think about them only in these specific moments. Now compare this to the user who is forced to spend every day using a badly designed information system and whose only option is conforming into silently cursing said system in their head throughout the whole process.

Although examples of invisible technologies can probably be found since

the dawn of humankind, when Mark Weiser introduced the concept, he was specifically proposing a new approach to the much more recent field of computing technology.

That explains in part why he later chose the term "calm" technology to better explain his ideas. The nuance here is important – the previous examples might give the false impression that he was simply referring to the process of *abstracting* specific, detailed steps into broader, more generic tasks, but that is not the case. The concept of abstraction is not only a fundamental part of Computer Science, but actually has existed for as long as human beings have. In fact, Pierce argues[iii] that human's interpretation of signs, and so we could say, our consciousness, is a potentially infinite chain of reinterpretations of symbols or transformations, which includes the formation of abstractions. While we do indeed use abstractions to reduce complex concepts and processes into a manageable amount of information, it doesn't necessarily mean that we become unaware or unworried about the inner workings of these more abstract steps, we may be just choosing to ignore them for some moments. Invisible technology, however, refers to systems that became so interconnected in our routine that, ideally, we never really have to be even aware of their existence. When Weiser talked about *calm* technology, he was proposing a new way of thinking design that aims at achieving invisibility or at least approaching it as much as possible. It's calm in the sense that it doesn't draw unnecessary attention from the user.

Attention is the key point here. As Weiser explained[iv], *obtrusive* technology requires the center of our attention and "bombard us frenetically" with information. *Calm* technology, on the other hand, "engages both the *center* and the *periphery* of our attention, and in fact moves back and forth between the two." In other words, calm technology only requires complete focus from the user in short, specific moments, moving to an unburdening position in the periphery of the mind when user's primary focus is no longer necessary.

A good modern example of the concept is the *weather forecasting umbrella*[v]. It is a "smart" umbrella that has a LED on its handle and is wirelessly

[iii] Peirce, C. S. The Collected Papers of Charles Sanders Peirce, Vol. I: The Principles of Philosophy. Harvard University Press, 1931.
[iv] Weiser M, Brown JJS. Designing Calm Technology. POWERGRID, Vol. 1, p. 1-5, 1996.
[v] Resner, B., Gandhi, P., Negroponte, N., Dredge, R., & Rose, D. Weather forecasting umbrella. U.S. Patent Application No. 11/699,314, 2007.

connected to the internet. If the forecast for the day predicts rain, the umbrella lights up, becoming immediately noticeable in the periphery field of view of any passerby, reminding them to bring it when leaving home. The user's focus is drawn only if necessary: on sunny days, when attention to its presence is no longer relevant, the device remains in its regular *invisibility*.

Weiser described a much simpler and yet just as good instance of the idea: the *dangling string*. A creation from artist Natalie Jeremijenko, it's simply a piece of plastic strip attached to an electric motor in an unused corner of the room. The motor is connected to the local ethernet cable and, as the network traffic becomes more or less intense, the variation on the signal causes more or less frequent twitches in the motor, making the plastic strip shake accordingly. The device can be seen and heard from a considerable distance but is not conspicuous, managing to give useful information in a fun way while still remaining unobtrusive. It's *calm* technology.

2. Designing for familiarity

Lead by Weiser's vision, a new field of research emerged to investigate how modern technology could be used to help users in their everyday tasks without being intrusive. The field was aptly named *ubiquitous* computing – computing everywhere – or *pervasive* computing – computing that spreads around; the understanding of the vision, however, wasn't always so apt.

If devices with communication and computational power would have any success into actually facilitating people's tasks in their daily routine, they would have to be able to correctly detect situations in which they could be useful and coordinate with other elements of the environment to create positive interactions with users. The technology simply didn't exist yet, and, actually, it still doesn't, as we shall see. So, naturally, the initial focus of research was in identifying and dealing with the inherent challenges posed by this new view[vi], such as heterogeneity of devices, scalability, context awareness and privacy issues, among others. However, once viable technology was developed that allowed everyday objects to become "smart" – communicating with each other, collecting and sharing information about the

[vi] Da Costa CA, Yamin AC, Geyer CFR. Toward a General Software Infrastructure for Ubiquitous Computing. IEEE Pervasive Computing, 2008.

environment and connecting to the internet, for example – many designers, especially those from big home-electronics companies, simply started putting chips on everything and calling it a day.

A very good example is the ongoing failure of smart fridges, a kind of appliance that is certain to show up in a new version every year on tech exhibitions, and yet never got even close to widespread adoption. Some of these devices would basically just have a screen on their door that could show up e-mail messages or the latest news, a feature that is certain to make anyone say in excitement: 'Well that's certainly an improvement – now I can do the same things I could do in my computer or smartphone, but from the uncomfortable perspective of hungrily standing in front of my fridge. As a plus, anyone passing by my kitchen can now read my private e-mails'.

Smarter approaches tried to automate "fridge related" tasks, such as keeping track of food waste and/or handling shopping lists. The idea seemed promising until it was put into practice: actual implementations required too much interaction from users by, for instance, asking them to scan bar codes or manually insert items – instead of helping, the technology just got in the way. More recent research[vii] is trying to fix just that problem, *i.e.*, developing technology that allows fridges to detect their contents automatically, without any input from owners, which is an extremely hard problem.

It's clear that Weiser's vision posed challenges much deeper than anticipated. His way of *thinking* design, though, could be immediately applied in any process. Advocating that technology should not be obtrusive – in other words, that user's attention should not be on technology itself but instead on their intended actions while using technology – is just another way of saying that design of technology should be *user-centered*. In fact, in his response to Weiser's ideas, Don Norman argues[viii] precisely that point, that "People are analog, not digital; biological, not mechanical. It is time for a human-centered technology, a humane technology".

A subtle and yet important difference is that, while *user-centered design* (UCD) focuses on finding the best way of allowing users to easily *express* their intentions and providing all and only the information the user needs in every

[vii] Sandholm T, Lee D, Tegelund B, et al. CloudFridge: A Testbed for Smart Fridge Interactions. https://arxiv.org/abs/1401.0585

[viii] Norman, Donald A. The Invisible Computer. MIT press, 1998

stage of their interaction with the system, we could claim that ubiquitous computing is worried about the same goals, but also about *predicting* actions that might be useful to the user in different contexts, which does sound a little patronizing – it means that your smart TV is trying to know what's best for you.

Nonetheless, the principle still remains that technology should be calm, *i.e.*, it should only *get in the way* when you want it to. A possible strategy to achieving that goal is to take one step further in the user centered design process and, before even considering how the user will interact with a system, consider which systems are actually necessary. While user-centered approaches can dramatically improve the experience of using existing systems, to develop calm technology we must take a moment to imagine ourselves in other people's feet, living through their entire daily routine, and wonder which technologies they might use, and whether these technologies require their attention because of an *intended action* from the user or if it's because of a particular nuisance or technical limitation. Are there tasks that a person must do frequently that would be easier or faster to do if the right piece of information was available just at the right moment? What if some repetitive procedure was automated or some data was automatically inferred and/or generated? What if some warning or useful reminder was shown in user's peripheral field of view precisely when necessary?

It stands to reason that general purpose, home-wide systems with such level of automation might be especially hard or even impossible to develop, but we can still apply the idea in small scales. Design of calm technology is design of the *familiar*. Users should feel estranged only when something is out of place and being out of place is precisely the point: for example, when a safety monitoring system triggers a warning of a dangerous situation. The weather forecasting umbrella's LED will only light up when the user's peace of mind *should* be shaken: 'Oh! I was about to forget my umbrella!'. An ideal version of such device would be able to perfectly detect when the user is about to leave and happens to be near it, lighting up only in that precise moment, otherwise remaining in its insignificant, *familiar* position at the corner of the room.

Design of the familiar can and should be strongly inspired by everyday items, but it's important to remember that familiarity is mostly connected to *context*. For instance, now that a whole generation of people has already been born in the internet era, it became common to find funny videos on YouTube of really small kids interacting with physical books and magazines, surprised when the content doesn't move as they scroll their fingers over the "screen". For these lucky kids, *touch screen* is the familiar, in contrast to that rough, soulless paper that we, old fashioned grown-ups, cherish so much.

Yet, it is still the case that *the most profound technologies are those that disappear*, and, as a logical consequence, only those that *remain*. A great rule-of-thumb is: if we have been doing something in the same way for a long time, one can't say for sure that it's the best way of doing it, but there's a very high chance that it indeed is. Take a good look at objects around you whose basic technology has now existed for centuries. What is it that makes them so familiar?

3. Out of sight, out of mind

But, really, should all technologies be familiar? Should all technologies be calm? Invisible? The same metaphor that allows one to passionately defend such ideas can also be used to criticize them, due to the inherent ambiguity of these concepts. There are many ways in which something can be familiar, and many reasons why it might have become invisible, and they are not always desired or well-intended.

For example, most modern smartphones are designed to be technological black boxes, in part because of technical requirements, but mostly because manufacturers have a strong incentive to make it impracticable or contractually impossible to fix or replace parts in these devices without resorting to authorized-only technical assistance services, which are often so expensive that most users just end up deciding to buy new ones. Those questionable practices are just one instance of the more generalized phenomenon of *planned obsolescence* – *i.e.*, designing products with an intentionally short lifetime, to ensure continuous consumption without any real necessity – but, sometimes, they also happen to line up with actual benefits for the user, from a certain point of view.

Apple's products, for example, became famous (at least in the beginning) for "*just working*". Because these devices are black boxes and there is only a very limited set of possible configurations, which are all completely controlled by the company, it is much easier to develop software that smoothly integrate all of them to offer a better user experience – making the technology much less *visible*. Their main competition – devices based on Google's Android operating system – are manufactured by dozens of different companies, who offer many options that range widely both in capacity and price. The toll paid for such level of flexibility, however, is an equally high level of inconsistency. Adding insult to injury, all those companies also manage to black box their products in their own accord. In the end, a person would have to be very naïve to believe that Apple, Google or any other company only have user's best interest in mind when they create these black boxes.

This issue became so prominent that recently it reached a point in which the activism from different groups advocating the *right to repair*[ix] and widespread user dissatisfaction successfully convinced many governments around the world to introduce new laws regarding that matter. It also exposes the conundrum to which many professional designers are submitted: they work for private companies that need to make a profit, and often the immediate consequence of that fact is a severe limitation on both freedom of exploration and time available to test different design choices, finding the ones that would produce the best possible user experience. We can even start to understand and feel some sympathy for the idealizers of those oversharing smart fridges after all.

A different source of *invisibility* that is often equally or even more controversial is *tradition*. And here too writing systems are a classic example. Let's investigate, for instance, the amusing fact that, despite it being the *de facto* lingua-franca of the planet, both native and non-native speakers of English often poke fun at the insanely ridiculous level of inconsistency of the language's written form. Many Americans, for example, are quite surprised to learn that the concept of *spelling bees* sounds almost absurd to speakers of most other languages that use the alphabet, due to the fact that these languages' spelling rules are simple enough that being able to write words

[ix] Check, for example, the manifesto at https://ifixit.org/right

correctly doesn't become a skill worthy of a nationwide televised competition. However, the reason why written English seems random to the uneducated eye is arguably a very fair one: there was a deliberate decision from generation after generation of speakers to keep the spelling of words mostly unchanged (or to change it very slowly), reflecting the original form from when those words were first written, which is actually quite consistent with how they sounded back then. This was done in the hope that modern speakers could easily see the origin and/or connections between words. Other languages such as Portuguese, for example, have suffered many orthographic reforms over time, reflecting the suppression or modifications of sounds or removing redundancies and inconsistencies, which makes it much easier to read and write any word correctly, even those the person had never heard before. Naturally, whenever one of those reforms occurs, there are many scholars who fight against the change, giving precisely the same arguments as English speakers give: by changing the written form, we are also throwing away part of the language's history, or at least making it less *visible*.

In some cases, that change can be quite drastic. Korean children, for example, have studied both kanji and hangul for many generations but, only a few decades ago, they started to learn hangul exclusively. Even though hangul is an amazing and beautifully designed phonetic system, the fact remains that kanji is still heavily used in the most mundane written communications in Korea. Even worse, some of the most historically important documents in the country are written completely in kanji, and thus effectively inaccessible to most of the younger generations. Japan, a country that has also developed a phonetic-only system, has yet never stopped using kanji for that same cultural preservation reason among many others, maybe the most important one being that Japan is almost synonym with tradition.

The most interesting aspect of tradition, though, is that it is always connected to *familiarity* – if something is traditional, it is necessarily familiar, and only what's first familiar can then become traditional. In that sense, writing systems are invisible *by definition* – since any successful writing system must necessarily be a tradition, they must also necessarily be familiar, *i.e.*, *invisible* technologies. Writing systems, then, become invisible technologies for the mere fact that we use them so often and so repeatedly

that they just *disappear* – even very complicated ones, such as English spelling or kanji.

Tradition is also often related, either in association or in direct opposition to another common source of invisibility: *convenience*. At first glance, one could hardly argue against the premise that if a system is more convenient it is better, right? But would you completely agree with statements such as 'So what if my phone is a black box? I only care that it is very convenient and simply works!' or 'What if reforming a language throws away part of my culture and history? I just want to be able to write without thinking about it, in a much more convenient way!'? Anyone can see that things are not that simple, we can all understand the fairness of the objections in those cases. But what about the water supply system, the power grid and the television broadcast networks? Aren't they just unarguably convenient without any downside?

Well, those are all cases in which invisibility, much like in the smartphone example, is quite literal: the water pipes and electric cables are literally hidden away, and electromagnetic waves used for radio and television are literally invisible to us, just like the inner chips of a smartphone or its operating system internal details. However, unlike in the smartphone example – where invisibility was also a way to take away control from the user –, in those cases, invisibility is just due to convenience – even if just aesthetic convenience. Nonetheless, even here we could make a philosophical argument against invisible technology – if you don't see it, you don't think about it and you don't give it proper respect and consideration. Famous architect Kiyoshi Ikebe makes an interesting analogy about this idea when he explains[x] that *shōji* – Japanese sliding doors made of wood and paper – is a kind of furniture that requires "manners", since they can be easily broken if mishandled. He points out that even though this kind of architectural feature requires special attention against possible rough treatment, as, for example, when there are children around, this is also a good opportunity to teach people proper consideration and care about things.

[x] 池辺陽. デザインの鍵–人間・建築・方法, 丸善, p 198-200. 1979.

If you take this point of view, you can see how we could be also "dumbing down" newer generations for the sake of convenience. When things are always easily accessible, we take them for granted and never reflect about them. If you ask small children living in cities where they think that milk comes from, they will probably answer that *it's from the box*, and some of them might become adults without ever changing that answer.

4. Mindful design

In previous examples, we could see a basic conflict of ideology. On one side, there are designers who think that users should be free from the burden of caring about technological details. Even when we discuss the case of black box smartphones, it's still possible to argue that, all questionable intentions aside, there are still advantages in having a smooth experience while using those devices, and they are clearly convenient. In this view, users should care only about their intentions, not about the specific inner workings of systems.

On the opposing side, we have designers who bring up different reasons for why users *should* care about technology: moral, cultural, philosophical or even educational ones. The common theme, though, is that people should be mindful about their environment and the inherent history and value of things, and they should learn proper care and respect for that environment. That perspective can be certainly described as more nostalgic or even artistic, but it is no less relevant.

You could argue that philosophical stances, although important for personal choices, should not be imposed to others. However, if you call yourself a designer, you have already ignored that argument to some extent. If, like Simon said, "everyone designs who devises courses of actions […]"[xi], then a designer is partly a "dictator", in the sense that they necessarily impose certain courses of action to the other people, even if to create a positive experience. Not only that, but claiming that convenience is always more important is a philosophical position in itself, just as the definition of convenience is, in many cases. In the writing systems example, even though it is overall convenient for learned users to have simpler spelling rules that

[xi] Simon, Herbert A. The sciences of the artificial. MIT press, 1996.

are consistent with the sounds of words, it's very inconvenient to reform a whole system from time to time and force the whole population to learn new spelling rules, after they had already tackled the complexities of the existing ones. Even if the system is complex, after you have learned how to use it, it becomes invisible just the same.

Convenience also depends on the actual results of choices, not simply the intended effect. For example, someone who personally puts a high value on the history of their language would try to find the origin and connections between words even if they weren't obvious in the written form. At the same time, the absolute majority of speakers don't care about that aspect at all, and really just want the easiest rules in their everyday usage – even when the roots and connections between words are clearly preserved in the written form, most people still miss them due to the natural invisibility of the system. You may design trying to make people care, but you will not necessarily always achieve that goal.

So, invisibility or deeper reflection, is there a winning side?

The trick here is that this is a false dichotomy. There's no true conflict, since you are not required to adopt only one of these strategies all the time. As long as you are *mindful* of which courses of action you are trying to guide the user to, but specially, if you are mindful of the user's intended actions and potential burdens, you can use design choices to either take those burdens away, making them invisible, or use them as a way to make people reflect, when there's a (philosophic, artistic) intention to do so.

Inquiry towards studies of design

+ What systems do you use everyday that are unobtrusive? Why are they so?
+ Can you find other reasons for why something would be invisible or familiar?
+ Do you think we are able to use writing systems without thinking about the inherent technology because there's something special about their design or because we are already so used to them? Is familiar really the same as invisible?